WHAT IS CLAIMED IS

1. A data recording device which records a multi-level data to a recording medium, comprising:

a block division unit dividing a sequence of input user data blocks into first blocks and second blocks;

a plurality of multi-level data generating units generating multi-level data blocks from both the first blocks and the second blocks output from the block division unit;

a group data storage unit storing first and second groups of code data corresponding to one user data block;

a plurality of averaging units each calculating an average of DC levels based on the multi-level data of one of the blocks output from the plurality of multi-level data generating units;

a level comparison unit comparing each of the DC level averages output from the plurality of averaging units with a predetermined value;

a revision data generating unit generating a revision data using a result of the comparison by the level comparison unit;

a data selection unit selecting one of the first and second groups of code data stored in the group data storage unit; and

an output storage unit storing the multi-level data of the first blocks, and the multi-level data of the second blocks generated by using the code data of the group selected by the data selection unit, in addition to the revision data output from the revision data generating unit.

2. The data recording device according to claim 1 wherein the multi-level data generating units include first and second multi-level data generating units, the first multi-level data generating unit generating a set of multi-level data blocks from the first blocks and the first code data group, the second multi-level data generating unit generating a set of multi-level data blocks from the second blocks and the second code data group, and the data selection unit selecting one of the first and second groups of code data such that a fluctuation of the DC levels is reduced to a given value by the selected code data group.

3. The data recording device according to claim 1 wherein the code data groups, stored in the group data storage unit, are provided so that the DC levels of the multi-level data blocks which

correspond to the first and second code groups serve as a candidate in a direction of plus or minus to a reference DC level used as a target.

4. The data recording device according to claim 1 wherein the code data groups, stored in the group data storage unit, are provided such that a total of the multi-level data which corresponds to one of the first and second code data groups for one user data block is an odd number of data blocks, and a total of the multi-level data which corresponds to the other of the first and second code data groups for the one user data block is an even number of data blocks.

5. The data recording device according to claim 1 wherein the level comparison unit is provided to compare the average of the DC levels calculated by one of the averaging units, with a target DC level, and observe a fluctuation of the DC levels based on the comparison result.

6. The data recording device according to claim 1 wherein the output storage unit is provided to store the multi-level data of the first blocks, the multi-level data of the second blocks and the revision data, and the revision data indicating which group of the code data is selected for the related multi-level data block such that a fluctuation of the DC levels is reduced to a given value by the selected code data group.

7. The data recording device according to claim 1 wherein the data selection unit is provided to select one of the first and second code data blocks stored in the group data storage unit, fixedly in accordance with a value of the revision data generated by the revision data generating unit for the first blocks in the user data block sequence such that a fluctuation of the DC levels is reduced to a given value by the selected code data group.

8. The data recording device according to claim 1 wherein the data selection unit is provided to select a fixed one of the first and second code data blocks stored in the group data storage unit, in

accordance with a value of the revision data generated by the revision data generating unit for a given period of the first blocks in the user data block sequence such that a fluctuation of the DC levels is reduced to a given value by the selected code data group.

9. The data recording device according to claim 1 wherein the data selection unit selects one of the first and second groups of code data stored in the group data storage unit, based on the revision data generated by the revision data generating unit.

10. A data recording device which records a multi-level data to a recording medium, comprising:

a modulator modulating the multi-level data into two or more data blocks;

an inverter reversing a most significant bit of each data block output from the modulator;

a first DC level calculation unit computing a DC level in each data block output from the modulator;

a second DC level calculation unit computing a DC level in each data block output from the inverter;

a DC level accumulation unit outputting a selected one of the DC level from the first DC level calculation unit and the DC level from the second DC level calculation unit; and

a level determination unit determining an accumulated sum value of each DC level of the first and second DC level calculation units and the selected DC level of the accumulation unit, wherein the level determination unit causing a selected one of the modulator and the inverter to output a corresponding data block as an output data block, based on a result of comparison of a first accumulated sum value of the DC level of the first DC level calculation unit and the accumulation unit and a second accumulated sum value of the DC level of the second DC level calculation unit and the accumulation unit, and the level determination unit outputting a selected one of the first and second accumulated sum values to the accumulation unit as a new selected DC level, based on the result of comparison.

11. The data recording device according to claim 10 wherein the level determination unit is provided to selectively output a smaller one of the first and second accumulated sum values to the accumulation unit as a new selected DC level, based on the result of

comparison.

12. The data recording device according to claim 10 wherein the level determination unit is provided to determine whether the most significant bit of the corresponding data block is reversed by using another bit of the corresponding data block other than the most significant bit when the output of the modulator or the inverter is selected as the output data block based on the result of comparison.

13. The data recording device according to claim 10 wherein the second DC level calculation unit is provided to compute a DC level by making reference to a most significant bit and a DC level of the corresponding data block before the bit reversing.

14. The data recording device according to claim 10 wherein the data recording device is provided to generate an odd number of

data blocks when the modulator modulates the multi-level data into the two or more data blocks.

15. The data recording device according to claim 10 wherein the data recording device is provided to fix one of the most significant bits of the two or more data blocks when the modulator modulates the multi-level data into an even number of data blocks.

16. The data recording device according to claim 10 wherein the respective data blocks modulated by the modulator are provided such that each data block include a number of bits having one of upper bits of the multi-level data before the modulation as a most significant bit of the data block, and a least significant bit of the data block generated from lower bits of the multi-level data before the modulation.

17. A data recording/reproducing device which reproduces from the recording medium the multi-level data recorded by the data recording device according to claim 10, comprising:

a demodulator transforming the multi-level data obtained from the recording medium, into an output multi-level data, the output multi-level data including a reversal bit indicating whether a most significant bit of the multi-level data is reversed; and

an output unit outputting a most significant bit of the output multi-level data which is reversed again, and outputting remaining bits of the output multi-level data without change when the reversal bit indicates that the most significant bit is reversed.

18. A data recording/reproducing method, comprising the steps of:

calculating accumulation values by adding two or more random numbers to a data respectively;

selecting a random number from among the respective random numbers based on each of the accumulation values; and

recording, to a recording medium, random number information indicating the selected random number, together with a corresponding one of the accumulation values calculated by adding the selected random number to the data.

19. The method according to claim 18 wherein, when recording the random number information and the corresponding accumulation value in the recording step, both a first error correcting code for the random number information and a second error correcting code for the corresponding accumulation value and the first error correcting code are recorded to the recording medium together.

20. The method according to claim 18, wherein the random number information is provided to indicate an initial value of the selected random number.

21. The method according to claim 18 wherein the random number information is provided to indicate an initial value of a

corresponding random number that is predetermined for the selected random number.

22. The method according to claim 18 wherein the random numbers are generated through a pseudo-random-number method, and a cyclic rotation number of the generated random numbers is set to be larger than a number of data items in the data.

23. The method according to claim 18 wherein each of the random numbers is updated for a unit of two or more data items in the data.

24. The method according to claim 23 wherein the random numbers are generated through a pseudo-random-number method, and a second pseudo-random number with a cyclic rotation number that is smaller than a number of data items in the data is further

added to the corresponding accumulation value calculated by adding the selected random number to the data.

25. The method according to claim 18 further comprising the steps of:

reading from the recording medium the corresponding one of the accumulation values and the random number information added to the corresponding accumulation value;

determining the selected random number based on the read random number information; and

adding a subsequently generated random number, which negates the selected random number, to the corresponding accumulation value so that the original data is reproduced.

26. A data recording/reproducing method, comprising the steps of:

suppressing both a component of a specific band and suppressing a low-pass frequency when transforming a multi-level data into a signal sequence; and recording the resulting signal sequence obtained in the suppressing step, to a recording medium.

27. The method according to claim 26, wherein the specific band is predetermined as being a band of a wobble signal.

28. The method according to claim 27, wherein the wobble signal is provided to include a signal indicating an address of the multi-level data in the recording medium.

29. A data recording/reproducing method, comprising the steps of:

determining a first power of specific frequency components in a unit of two or more data items in the multi-level data;

determining a second power of the specific frequency components after upper bits of the unit of two or more data items are reversed;

selecting a smaller one of the first and second powers of the specific frequency components for the unit of two or more data items;

adding identification information which indicates the upper bits of the unit are reversed, to the unit of two or more data items; and

recording, to a recording medium, the identification information and the unit of two or more data items together by using the selected power.

30. The method according to claim 29, wherein the first and second powers of the specific frequency components are determined based on a Discrete-Fourier-Transform method.

31. A data recording method, comprising the steps of:

determining a first DC level accumulation value of a unit of two or more data items in a multi-level data, and a first power of specific frequency components of the unit;

determining a second DC level accumulation value of the unit and a second power of the specific frequency components of the unit when upper bits of the unit are reversed;

selecting a smaller one of the first and second DC level accumulation values and a smaller one of the first and second powers of the specific frequency components for the unit;

adding identification information which indicates upper bits of the unit are reversed, to the unit of two or more data items; and

recording, to a recording medium, the identification information and the unit of two or more data items together by using the selected DC level accumulation value and the selected power.

32. A data recording method, comprising the steps of:

determining a first DC level accumulation value of a unit of two or more data items in a multi-level data, and a first power of specific frequency components of the unit;

determining a second DC level accumulation value of the unit and a second power of the specific frequency components of the unit when upper bits of the unit are reversed;

selecting one of the first and second DC level accumulation values and one of the first and second powers of the specific frequency components with which a sum of a square of the DC level accumulation value and a square of the power of the specific frequency components is smaller;

adding identification information which indicates the upper bits of the unit are reversed, to the unit of two or more data items; and

recording, to a recording medium, the identification information and the unit of two or more data items together by using the selected DC level accumulation value and the selected power.

33. A data recording/reproducing method, comprising the steps of:

determining a first DC level accumulation value of a unit of two or more data items in a multi-level data, and a first power of specific frequency components of the unit;

determining a second DC level accumulation value of the unit and a second power of the specific frequency components of the unit when upper bits of the unit are reversed;

selecting one of the first and second DC level accumulation values and one of the first and second powers of the specific frequency components with which a sum of a square of the DC level accumulation value and a square of the power of the specific frequency components multiplied by a given coefficient is smaller;

adding identification information which indicates the upper bits of the unit are reversed, to the unit of two or more data items; and

recording, to a recording medium, the identification information and the unit of two or more data items together by using the selected DC level accumulation value and the selected power.

34. The method according to claim 29 wherein a data length of the unit of two or more data items in the data is set to be less than 1/2 of a data length of a signal sequence corresponding to one period of a specific frequency.

35. The method according to claim 29 wherein a data length used in the determination of the power of the specific frequency components is set to be larger than a data length of the unit of two or more data items in the data.

36. The method according to claim 29, further comprising the steps of:

reading out a signal for the unit of two or more data items from the recording medium, the read-out signal containing the unit of two or more data items and the identification information; and

reproducing the original data by reversing upper bits of the unit of two or more data items obtained from the read-out signal, based on the identification information obtained from the read-out signal.